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# THE ROLE OF COLLECTIVE INTELLIGENCE IN DESIGN

*A protocol study of online design communication*

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**Abstract.** Web-enabled collective intelligence in design invites anyone to contribute to a design process through crowd-sourcing. We use a protocol analysis method to analyse the forum data on a collective intelligence web site, studying communication among individuals who are motivated to participate in the design process. A protocol analysis allows us to compare collective intelligence in design to similar studies of individual and team design. Our analysis shows that a design process that includes collective intelligence shares processes of ideation and evaluation with individual and team design, and also includes a significant amount of social networking. Including collective intelligence in design can extend the typical design team to include potential users and amateur perspectives that direct the design to be more sensitive to users' needs and social issues, and can serve a marketing purpose.

**Keywords.** Collective intelligence; design process; protocol analysis; design communication

## 1. Introduction

As knowledge workers become geographically dispersed, and increasingly contribute to projects outside their regular employment in what Jeff Howe describes as their 'spare cycles', a growing need for networked communication tools that support distributed, informal collaboration has become apparent.

Some online communities, such as *Quirky.com, MyooCreate.com, 99Designs.com* and *OpeningDesign.com,* that recognise the value in attracting

diversity of opinion and supporting various levels of volunteer involvement, have emerged in the design domain. *Quirky* is a platform for collaborative product development, where the community works together with a dedicated in-house design team to bring products from idea to market. *Myoo* (me + you) *Create* provides a platform for designing solutions for environmental and social issues. *99Designs* (along with many other graphic design sites such as *TopCoder Studio* and *DesignCrowd*), crowd-source logos, websites and other marketing needs - and show that a company can receive a massive pool of unique conceptual designs by leveraging the diversity of the crowd through competition. *OpeningDesign* is a recently launched platform for architecture and urban planning, involving various stakeholders of a project and providing a space for opinion polls and crowd-sourcing jobs.

These platforms rely on community participation, both amateur and professional, and their websites support public discussion at multiple levels of involvement. They attract a range of inputs, from the casual observer who might be motivated to comment once or twice, to the active contributor who closely tracks progress and responds often and with minimal delay. While we don't always see the full spectrum, we are seeing different levels of engagement as described in the Reader-to-Leader framework for technology-mediated social participation (Preece and Schneiderman, 2009).

## 2. Studying design by protocol analysis

Protocol studies of designers provide an analysis of the design thinking process. The 1996 Delft workshop on Analysing Design Activity (Cross *et. al*) provided recorded data of both individual and co-present synchronous team design activity. The many papers that resulted from the workshop compared and contrasted these two ways of designing using different coding schemes to highlight different design models and processes. Since design communication can now be computer-mediated, protocol analyses have been applied to team communication via computer interfaces (see for example, Gabriel and Maher, 2000). Now that the social web has become mainstream and design platforms are supporting crowd-sourcing and the many incarnations of collective intelligence, we can apply protocol analysis to design communication in collective intelligence approaches to designing.

Studying collective intelligence in design is a progression in design research where a key communication variable has been changed: from team co-present synchronous communication, to distributed team computer-supported-synchronous communication, to collective computer-supported-asynchronous communication. This leap to collective intelligence or crowd-sourcing supports design communication through asynchronous discussions

and scales up design participation through an open invitation to the world. In this paper we begin to examine the role crowd-sourcing plays in design by analysing asynchronous design communication from the Quirky web site.

## 3. A study of design communication

Our study of collective intelligence varies from traditional protocol analysis in design research in employing an ethnographic method of enquiry, using case studies rather than controlled experiments. The data was collected from the discussion forums associated with publicly available design projects on the Quirky web site. There are two main approaches to analysing designing: (i) process oriented analysis, which examines problem-solving actions and design strategies; and (ii) content-oriented analysis, which focuses on "what designers look for, see, do, and possibly think" (Dorst and Dijkhuis, 1995). Our study combines the two by first coding according to design process and then coding the content within each process.

### 3.1 QUIRKY.COM OVERVIEW

Quirky was selected for analysis as it is a commercially successful example of an open community used in design practice and a readily available representative of a class of systems for collective design.

The Quirky website gathers new product ideas from individuals and presents them to the crowd, effectively an ideas popularity contest. Each week, the new product idea with the most votes is selected for development. The crowd is sourced from people who choose to participate and make contributions, and these volunteers are involved in the design process at key stages, such as during ideation and evaluation. The overall design process and major design decisions are managed by a dedicated in-house design team. This dualistic model relies on both a design crowd and a design team, and uses communication tools and platforms to bring out the strengths of each in order to quickly bring products to market in a profitable way.

Design development time is typically very fast. For example, the Switch Modular Pocket Knife was developed in about a month, with four days spent on industrial design, four days on a second iteration of industrial design, one day on product naming, four days on coming up with a tagline and three days on logo design.

Design activity by the crowd is both textual and visual (images and video). Design communication between the crowd and the team is web-based, with forum pages dedicated to each aspect of product development. Design activity by the team takes place offline, with the outcomes of each stage in product

development made available online to the crowd.

### 3.2 SOURCING AND SEGMENTING THE DATASET

Design communication data was obtained from three different product design public forums on Quirky.com: a waffle maker, a switchblade, and an iPad cover. These three projects were selected for analysis from the range of completed designs available online. The forum data for each project comprise a continuous stream of chronologically ordered text. Segmentation occurred at three levels: the speaker level, the sentence structure level, and the code level. At the first level, the data was segmented whenever a new person added a comment. At the second level, each person's comments were segmented at sentence breaks. At the third level a sentence was segmented so that each segment could be assigned only one code. The number of segments for each design case is: waffle maker: 265 segments, switchblade: 426 segments, and iPad cover: 88 segments.

### 3.3 CODING SCHEME

We started with the design communication coding scheme for analysing team design communication about design ideas in Gabriel and Maher (2000): Introduction, Acceptance, Rejection, Clarification, Confirmation, Development, Repetition, Referencing, Revisiting, and Evaluation. A pilot study applying these codes to our data set revealed that these ten codes, being developed for coherent design team communication, were not all appropriate for design crowd communication. For example, Revisiting assumes that the members of the team are all present and are recalling a previous part of the discussion. In a design crowd all individuals are not present at the same time and revisiting an idea does not have the same meaning. We clustered these ten codes into three groups: Ideation, Evaluation, and Referencing as a way of comparing our results to the Gabriel and Maher results, and to provide meaningful codes for design crowd communication.

When we coded the dataset to this higher-level of classification we added two codes: Qualification and Social communication. Qualification is applied to segments that establish the credibility of the individual's contribution, such as describing the history of their use of the product undergoing development. Social communication is applied to segments that have commentary of a general, social nature, such as emoticons, funny asides, or words of encouragement.

To understand the aspect of the design product being discussed in ideation, evaluation and referencing, we applied Gero's FBS ontology (Gero

and Kannegiesser 2007). For example, Ideation – function is assigned to a statement that is a about a design idea related to the function of the design, that is, its purpose; Ideation – behaviour is a statement about a design idea related to the behaviour of the design, that is, its performance or other feature derived from the structure of the design. Similarly, Ideation – structure is about a geometric or material property of the design. Our final coding scheme is shown in Table 1.

Table 1. Final protocol classifications

| Term (abbreviation) | Description |
|---|---|
| Ideation – function (IF) | A concept dealing with the product's purpose or user needs |
| Ideation – behaviour (IB) | A concept for how the product, or a feature of the product should perform: what it does |
| Ideation – structure (IS) | A concept related to the product's physical properties: how it should look or how it is composed |
| Evaluation – function (EF) | An appraisal of the product or concept's purpose |
| Evaluation – behaviour (EB) | An appraisal of the product or concept's ability to perform or do something |
| Evaluation – structure (ES) | An appraisal of the product or concept's physical properties: how it could look or how it might be composed |
| Referencing - function (RF) | Referring to an existing product's function. |
| Referencing – behaviour (RB) | Referring to an existing product's behaviour. |
| Referencing – structure (RS) | Referring to an existing product's structure. |
| Social Communication (SC) | Commentary of a social nature. |
| Qualifications (Q) | Establishing an individual's background to support opinion |
| Uncoded (U) | Unclassified segment |

## 3.4 PROTOCOL CODING PROCESS

We first coded segments into Ideation, Evaluation, Referencing, Qualifications and Social communication. For Ideation, Evaluation, and Referencing segments, we further coded them as F, B, or S. This further coding required more deliberation to disambiguate F, B, and S. An example of this is the design discussion of the waffle maker, where one person commented: "With all this talk of non-stick, I believe silicone molds [sic] and/or surfaces would be the solution." In this example, 'non-stick' is the context in which silicone moulds were proposed. Although non-stick-ability in this context is behaviour of the product, the proposed idea related to the product's physical properties and therefore the segment was coded as ideation-structure. Ideation-function was determined by user needs, as in the example: "It would also be nice to offer a solar powered option for the 2 or 3 seasons when most people are camping". The segment immediately proceeding: This flexibility would really help it to reach a broader market", (also by the same person) was coded as ideation-behaviour, as the marketability of a product is a behaviour of the product.

Evaluation ranged from mentioning the pros and cons of the various ideas to commentary of a more general nature aimed at verbalising support (i.e. "Love this idea!"). If the person described what it was about the product they loved, it was classified accordingly. For example in the Switch pocket knife dataset the segment: "I love the idea of being able to pick what is included" was coded as evaluation-function, as the ability to select components is a user need. An example of evaluation-behaviour was the segment: "For any sustainability this would have to be a high quality unit, if you cut corners you would never get the cult following necessary for this to travel word of mouth". Sustainability and cult-following are behaviours of the product. If an evaluation segment alluded to the structure of the product, it was classed as evaluation-structure, such as: "Unfortunately, I think you might have to jettison the idea of modularity!"

It was more difficult to classify Referencing into FBS as often the required information was not provided. Referencing often took the form of links to external webpages. In a large number of cases, the link was provided without any accompanying text, or the accompanying text was classified as general discussion such as, simply: "inspiration".

### 3.5 RESULTS

Table 2 shows the percentage of segments in each of the top level codes.

Table 2. Quirky Data Top-Level Results

| | Waffler % | Switch % | Cloak % | mean % |
|---|---|---|---|---|
| I | 27 | 33 | 44 | 34.67 |
| E | 24 | 22 | 31 | 25.67 |
| R | 12 | 8 | 8 | 9.33 |
| S | 34 | 36 | 17 | 29.00 |
| Q | 1 | 1 | 0 | 0.67 |
| U | 2 | 0 | 0 | 0.67 |

The majority of segments were within three areas: Ideation (34.67%); Social communication (29%); and Evaluation (25.67%). Referencing was 9.33%; and Qualifications and Uncoded segments were both 0.67%.

Table 3 shows the percentages of segments in the content areas of Function (F) Behaviour (B) and Structure (S) within each of the top level design process codes. U indicates that the segment did not correspond to F B or S, that is, Uncoded. Within Ideation, all segments were related to F, B, or S, and the greatest focus by far was on Structure (IS=58.3%) followed by Behaviour

(IB=23.33%) and Function (IF=23.33%). Evaluation showed a similar breakdown with 47.33% dedicated to appraising Structure (ES), 29.33% for Behaviour (EB) and 22.67 for Function (EF).

Table 3. Quirky results breakdown

| | Waffler % | Switch % | Cloak % | mean % |
|---|---|---|---|---|
| IF | 28 | 15 | 13 | 18.67 |
| IB | 19 | 25 | 26 | 23.33 |
| IS | 53 | 60 | 62 | 58.33 |
| IU | 0 | 0 | 0 | 0.00 |
| EF | 11 | 24 | 33 | 22.67 |
| EB | 34 | 35 | 19 | 29.33 |
| ES | 53 | 41 | 48 | 47.33 |
| EU | 1.6 | 0 | 0 | 0.53 |
| RF | 9.7 | 11 | 14 | 11.57 |
| RB | 29 | 24 | 0 | 17.67 |
| RS | 13 | 43 | 86 | 47.33 |
| RU | 48 | 22 | 0 | 23.33 |

The largest number of uncoded segments occurred in Referencing (RU) with 23% as opposed to 0.53% for Evaluation and 0% for Ideation.

## 4. Observations and analysis of results

Protocol analysis proved to be a useful method for gaining insight into the role of collective intelligence in design. The development and modification of the coding scheme provides some insight into the nature of communication in design crowds. We observed that individuals were not interacting synchronously or continuously, but engaging on the forum at various times over an extended period. Not all individuals were keeping track of the history of design communication, which resulted in recently added design commentary often being very similar to those previously stated - not a simple case of revisiting or repetition, but of two independent, but essentially identical contributions.

We also observed that participants were augmenting their design contributions with social discourse not directly related to the design, but instrumental in persuading individuals of their view or for establishing credibility and rapport. Two additional communication codes were added to describe this dataset: ‘social communication which consisted of emoticons, jokes, and comments such as “so....hmmmm”; and ‘qualifications’, which occurred when users voluntarily stated their past experience or credentials in

order to convince the community that their contributions had value.

Qualifications segments did not occur in as large a proportion as we had anticipated. Other collective intelligence in design sites, such as TopCoder, incorporate complex qualification measures into their user profiles, so having such a low rate in this dataset may be a reflection of Quirky's system structure, where domain expertise lies mostly with their dedicated in-house design team. This low score for qualifications is similar to the low mentions of qualifications among team designers, but for a different reason: members of design teams have existing, established and recognised credentials and don't need to remind each other of their backgrounds. In many cases in team design, individuals had been selected specifically for what each member can bring to the design process. In the examples of crowd-sourcing studied here, members know each other only by their screen name. As the same core group of members work on multiple projects together, they may build up a rapport and shared history, but if establishing qualifications was so important, they would still need to convince new members of their qualifications with each post, as they cannot rely on them to have canvassed and remembered comments from the past or from other forums. From this, we can assume that establishing qualifications do not hold a great deal of importance, and that members behave in an egalitarian manner.

Social communication was a relatively large percentage of the communication content. Being part of the community may be strong motivation for people to contribute to these sites (see Maher et al 2010). Socialising is a natural human behaviour to help create and reinforce bonds. Since the text-based forums strip individuals of body language and tone, they find other ways of establishing rapport. Emoticons and general social comments fill that need. Since they have no regular meeting space outside of the forum, these behaviours occur within the design forums.

The vast majority of the crowd's contributions, both in ideation and evaluation, lie in the area of product structure. The psychological response to product form is perhaps one of the most fundamental components of a purchasing decision (Bloch 1995), and the design crowd is largely composed of end-users (more so than the design team). Although end-users have a vested interest in ensuring the product suits their needs (function), these needs are often not as highly articulated as opinions on aesthetics and composition; attributes which arise directly from those needs.

## 5. Conclusions

The Quirky approach to design provides a successful template for incorporating an open, diverse crowd into the design process. It recognises the strengths of

the crowd and the design team, and organises them in such a way as to bring the most out of the interaction. By recognising the crowd as a potential future market and understanding the benefits of placing end-users within the design process, Quirky leverages the crowd's diversity of opinion at the key stages of ideation and evaluation to broaden the solution space and ensure the product design evolves in the direction of popular appeal.

In the following paragraphs, we comment on key aspects of the nature and role of the crowd in current collective intelligence in design communities.

Managed vs. Self-organised: The crowd is an amorphous entity, with individuals partaking in varying degrees. Although each individual is motivated to participate, the crowd lacks organisational structure. In some cases a crowd can be efficient at self-organising and achieving a great many things within imposed time constraints, such as the I Love Bees game (McGonigal 2008), which reached the objectives of the game's designers with no externally imposed organisation or rules. With I Love Bees, the crowd was of an extremely large size (over 600,000 participants), most of who were devoted fans of the existing Halo computer game. In contrast, Quirky's crowd is small in number, with usually only a dozen regular volunteers on any given project. Added to this is the pressure of bringing a product to market in a timely fashion, and to have a mechanism for decision making. Quirky have addressed this by hiring a dedicated, experienced, in-house design team to take responsibility for the product's progress.

Users as designers: Advertisers run focus groups to gauge how best to present a product according to the user's needs. Producers screen films to preview audiences to assess their reaction and make editorial changes to the material in accordance with their findings. It is also beneficial to include end users in product design. Enduring involvement with a product gives individuals a greater sense of emotional connection with the product; a higher likelihood of purchasing the item and higher rates of reported satisfaction with the product after purchase (Sharon et al 1988). No involvement is more enduring than following a product from idea to market. This seems to be supported by the success of Threadless.com for crowd-sourced t-shirt design; RYZ.com for sneaker design and Quirky.com for product design. Since the members of a crowd are already significantly invested in the product in terms of an emotional connection over time, but can also be financially vested (top influencers at Quirky get a cut of the profit), they are more likely to purchase the product and tell people about it.

Our conclusions are based on an analysis of data from three projects on Quirky and our observation of other web sites that crowd-source design activity. Although generalised statements about collective design cannot be

made with a sample of this scope, the observations and experiences outlined here identify key patterns that will benefit from further investigation. An additional contribution of this study is a methodology for analysing collective design, which is useful in an area of research that is still forming.

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